National Aeronautics and Space Administration

Instrumentation

Ground-to-Space Laser Calibration System

Ground-based system to calibrate Earth observing sensors measuring reflected radiance in Low and Geostationary orbits

NASA Langley Research Center has developed the Ground-to-Space Laser Calibration (GSLC) System concept for calibrating earth observing sensors measuring reflected radiance. GSLC is capable of calibrating sensitivity to polarization, degradation of optics, and response to stray light of spaceborne reflected solar sensors. The concept is based on using an accurate ground-based laser system pointing at and tracking the instrument on orbit during nighttime and clear atmosphere conditions. The GSLC system will be applicable to instrument calibration in both, low earth and geostationary earth orbits.

BENEFITS

- Presents an alternative to calibrating on-board: reliable calibration of optics instrumentation from the ground.
- Capable of calibrating sensitivity to polarization, degradation of optics and the instruments' response to stray light of space borne reflected solar sensors.
- Polarization parameters of laser light are not affected by a clear atmosphere even if laser intensity changes between the surface and orbit.

APPLICATIONS

- Earth observing sensors measuring reflected radiance from low and geostationary orbits.

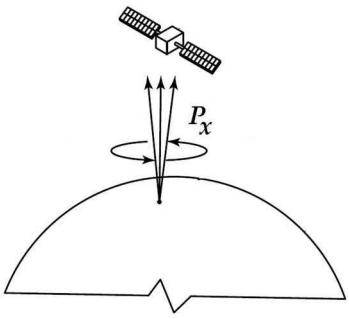
technology solution

THE TECHNOLOGY

The quality of earth science data products based on observations from spaceborne radiometric sensors depends on their performance and accuracy on orbit. The accuracy of measuring reflected solar radiance can be affected by multiple factors. First, instruments with complex optics are sensitive to polarization. The response of such instruments is characterized before the launch, however, sensitivity to polarization can change on orbit significantly. Other factors are the degradation of optics, particularly in blue wavelength range below 500 nm, and on-orbit changes in the instrument response to stray light. None of the existing sensors has the ability to monitor all these changes in calibration on orbit.

Accurate verification of space born sensors calibration on orbit plays a crucial role in meeting mission accuracy requirements. Onboard verification systems significantly impact mission costs by increasing the mass of instrumentation and required power. Also, onboard verification systems are not accessible for adjustment, maintenance, improvement, or repairs in the case of failure. Accordingly, a need exists for an improved calibration concept that does not suffer from the drawbacks of known calibration systems and methods.

The present invention comprises an approach for calibrating the sensitivity to polarization, optics degradation, spectral and stray light response functions of instruments on orbit. The calibration is achieved by transmitting an expanded and uniform laser beam to the instrument in low earth or geo-stationary orbit (during nighttime clear sky conditions), and varying beam polarization and its wavelength within short time intervals. The expanded beam with uniform top-hat profile, generated by ground-based laser system, is aimed at and transmitted to the satellite, whereby entire aperture of the optical sensor on the satellite is exposed to transmitted light. The optical sensor measures the intensity of incident signal on orbit while operations with beam polarization and wavelength are performed using optics on the ground.



Concept of calibration sensor sensitivity to polarization in low Earth orbit

PUBLICATIONS

Patent No: 8,767,210; 9,052,236

More Information

National Aeronautics and Space Administration

The Technology Gateway

Langley Research Center

Mail Stop 151
Hampton, VA 23681
757-864-1178
LARC-DL-technologygateway@mail.nasa.gov

http://technology.nasa.gov/

www.nasa.gov

NP-2015-08-2025-HQ

NASA's Technology Transfer Program pursues the widest possible applications of agency technology to benefit US citizens. Through partnerships and licensing agreements with industry, the program ensures that NASA's investments in pioneering research find secondary uses that benefit the economy, create jobs, and improve quality of life.

LAR-18202-1, LAR-18202-2